

We claim:

1. A brake booster (12) having a housing with an interior separated into at least a first chamber (26,26') and a second chamber (28,28') by a wall (21) connected to a hub (50), said hub (50) having a 5 cylindrical body (54) with an axial bore (55) that extends from a first end (56) to a second end (58), a control valve (100) located in said axial bore (55) for sequentially connecting said first chamber (26,26') with said second chamber (28,28') to provide for the equalization of fluid pressure therein in a first mode of operation and interrupting communication 10 between said first (26,26') and second (28,28') chambers while connecting said second chamber (28,28') to a surrounding environment to allow air to enter into said second chamber (28,28') and create a pressure differential across said wall (21) in response to an operational signal to defining a second mode of operation, said pressure differential 15 acting on said wall (21) to develop an output force that is communicated through said hub (50) to an output push rod (222), said output force, after overcoming a return spring (240), moving said output push rod (222) to supply pistons located in a master cylinder (13) with an operational input to pressurize fluid in the master cylinder (13), said 20 pressurized fluid from the master cylinder (13) being communicated to wheel brakes (14,14'18,18') to effect a brake application, said brake booster (12) being characterized by a first input member (30) connected to said control valve (100) and responsive to an operator input for moving said control valve (100) from said first mode to said second 25 mode to develop a corresponding first brake application, a second input member (200) being connected to said control valve (100) and responsive to an electrical input under the control of an electronic control unit (ECU)(40) for moving said control valve (100) from said first mode to said second mode to develop a corresponding second brake application 30 and switch means (300) responsive to movement of said control valve (100) by said second input member (200) to provide said ECU (40) with a first signal confirming the development of said second brake application

and responsive to movement of said control valve (100) by said first input member (30) to provide said ECU (40) with a second signal whereby said electrical input to said second input member (200) is terminated and immediate development of said first brake application is initiated, said control valve (100) having a poppet assembly (101) with a flexible tubular section (102) secured to a collar assembly (108) to define a unitary structure, said tubular section having a bead (104) on a first end that is secured to said cylindrical body (54) by a first retainer (120) that is fixed to said cylindrical body (54) and a lip (106) on a second end that is secured to a collar (108) assembly, said collar assembly (108) having a flange (110) on a first end and a second end that is secured to said second end of said flexible tubular section (102), said control valve (100) having a washer (112) that is integral with said lip (106) and a first annular surface (114) on said lip (106) that defines a first seat while said collar assembly (108) has a second annular surface (118) thereon that defines a first face, said control valve (100) including a first spring (130) that is located between said first retainer (120) and said washer (108) for urging said second annular surface (118) on said collar assembly (108) toward a second seat (62) in said cylindrical body (54), said control valve (100) having a first plunger (132) with a shaft that extends from a base on a first end (136) to a second end (140), said base having a stepped bore (152) therein for receiving a head (31) on a push rod (30) of said first input member, said shaft having a first diameter (134) for said base, a second diameter (138) adjacent said second end (140) and a third diameter (142) located there between, a cylindrical member (154) that surrounds said base of said shaft having a third annular surface (166) thereon that defines a second face (159), and a second spring (164) that is located in said stepped bore (152) of said base for urging said second face (159) away from said first end (136) of said shaft and toward said first seat, a third spring (170) that is located between said first retainer (120) and said push rod (30) for urging said first plunger (132) toward said first retainer (120) to bring said second face (159) into engagement

with said first seat while moving said second annular surface (118) away from said second seat (62) during said first mode of operation, said second input member (200) having a second plunger (202) that surrounds said third diameter (142) on said shaft of said first plunger (132), a solenoid (201) that is concentric to said second plunger (202) and linkage (400) that connects said second plunger (202) with said cylindrical member (156) that surrounds said base of said first plunger (132), said solenoid (201) on receipt of said electrical input acting on and moving said second plunger (202) within said axial bore (55) and correspondingly moving said cylindrical member (156) and said second face on said third annular surface (166) away from said first seat after said first spring (130) moves said second face on said second annular surface (118) on said collar into engagement with said second seat (62) to allow air to be communicated to said second chamber (28,28') and initiate development of said second brake application during said second mode of operation, said second input member (200) in developing said second mode of operation moving said hub (50) while said first plunger (132) initially remains stationary such that a switch plunger (302) on said switch means (300) is located on said second diameter (138) of said shaft to provide said first signal to said ECU.

2. The brake booster as recited in claim 1 further characterized by a key (150) that extends through said cylindrical body (54) and engages said first plunger (132) to limit the axial movement of said first plunger (132) within said axial bore (55) and which engages said housing (153) to define a rest position for said first plunger (132) in said first mode of operation.

3. The brake booster as recited in claim 1 wherein said first input member (30) moves said first plunger (132) to bring said third diameter (142) on said shaft into contact with said switch plunger (302) on said switch means (300) to provide said second signal to said ECU.

4. A brake booster having a housing separated into at least a first chamber and a second chamber by a wall connected to a hub, said hub

having a cylindrical body with an axial bore that extends from a first end to a second end, a control valve located in said axial bore for sequentially connecting said first chamber with said second chamber to provide for the equalization of fluid pressure therein in a first mode of operation and 5 interrupting communication between said first and second chambers while connecting said second chamber to a surrounding environment to allow air to enter into said second chamber and create a pressure differential across said wall in response to an operational signal to defining a second mode of operation, said pressure differential acting on 10 said wall to develop an output force that after overcoming a return spring, moves a output push rod to pressurize fluid in a master cylinder to effect a brake application, said brake booster being characterized by a first input member connected to said control valve and responsive to an operator input for moving said control valve from said first mode to said 15 second mode to develop a corresponding first brake application, a second input member being connected to said control valve and responsive to an electronic control unit for moving said control valve from said first mode to said second mode to develop a corresponding second brake application and switch means responsive to movement of said wall by a 20 pressure differential created by said second input member moving said control valve to provide an ECU with a first signal confirming the development of said second brake application and thereafter responsive to movement of said control valve by said first input member to provide said ECU with a second signal whereby an electrical input to said second 25 input member is terminated and said first brake application is under the control of an operator, said control valve valve is characterized by:

30 a poppet assembly having a flexible tubular member that is secured to a collar to define a unitary structure, said unitary structure including a bead on said flexible tubular member that is fixed to said cylindrical body by a first retainer, a lip on said flexible tubular member and a flange on said collar, said lip having a first annular surface that

defines a first seat while flange has a second annular surface thereon that defines a first face;

5 a first spring that is located between said first retainer and said lip for urging said second annular surface toward a second seat in said cylindrical body;

10 a first plunger having a shaft that extends from a base on a first end to a second end, said base having a stepped bore therein for receiving a head on a push rod of said first input member, said shaft having a first diameter for said base, a second diameter adjacent said second end and a third diameter located there between, a cylindrical member that surrounds said base of said shaft having a third annular surface thereon that defines a second face;

15 a second spring that is located in said stepped bore of said base for urging said second face away from said first end of said shaft and toward said first seat, a third spring that is located between said first retainer and said push rod for urging said first plunger toward said first retainer to bring said second face into engagement with said first seat while moving said second annular surface away from said second seat during said first mode of operation;

20 a second plunger that surrounds said third diameter on said shaft of said first plunger;

a solenoid that is concentric to said second plunger; and

25 linkage that connects said second plunger with said cylindrical member that surrounds said base on said first plunger, said solenoid on receipt of said electrical input acting on and moving said second plunger within said axial bore and correspondingly moving said cylindrical member and said second face on said third annular surface away from said first seat after said first spring moves said second face on said second annular surface on said collar into engagement with said second seat to allow air to be communicated to said second chamber and initiate 30 development of said second brake application during said second mode of operation, said second input member in developing said second brake

application moving said hub while said first plunger initially remains stationary such that a switch plunger on said switch means is located on said second diameter of said shaft to provide said first signal to said ECU.

5        5. A brake booster having a housing with an interior separated into at least a first chamber and a second chamber by a wall connected to a hub, said hub having a cylindrical body with an axial bore that extends from a first end to a second end with a control valve assembly located therein for sequentially connecting said first chamber with said 10 second chamber through a first passage to provide for the equalization of fluid pressure therein in a first mode of operation and interrupting communication through said first passage while connecting said second chamber to a surrounding environment through a second passage to allow air to enter said second chamber and create a pressure differential 15 across said wall in response to an operational signal in a second mode of operation, said pressure differential acting on said wall to develop an output force that after overcoming a force of a return spring is transmitted through said hub to an output push rod that moves pistons located in a master cylinder to pressurizes fluid that is communicated to 20 wheel brakes to effect a brake application, said brake booster being characterized by a first input member that is connected to said control valve assembly and responsive to an operator input for moving said control valve assembly from said first mode of operation to said second mode of operation to develop a first brake application, a second input 25 member that is connected to said control valve assembly and responsive to an electrical input under the control of an electronic control unit for moving said control valve from said first mode of operation to said second mode of operation to develop a second brake application and switch means initially responsive to movement of said hub in said 30 second mode of operation by said second input member for providing an ECU with a first signal confirming the development of said second brake application and thereafter responsive to movement of said control valve

assembly by said first input member to provide said ECU with a second signal whereby said second brake application is immediately terminated and said first brake application is initiated, said control valve being characterized by:

5        a first cylindrical member that is sealingly located in said axial bore, said first cylindrical member having an annular face thereon that defines an vacuum seat;

          a retainer fixed to said cylindrical body of said hub and sealingly engaging said first cylindrical member;

10        a first spring located between said retainer and said first cylindrical member for urging said annular face toward a first seat associated with said first passage in said hub;

15        first plunger means including a first shaft and a second shaft, said first shaft having a first diameter adjacent a first end and a second diameter adjacent a second end with third diameter located there between to define a groove between said first and third diameters, said first end of said first shaft having a bore for receiving a head on a push rod of said first input member, said second shaft having a first end that contacts said second end of said first shaft and a second end that contacts a 20 reaction disc associated with said output push rod;

          a second cylindrical member having a stepped bore that surrounds said first and third diameters of said first shaft, a first end with a face thereon that defines an atmospheric seat, a second end with a lip thereon, a first shoulder located on its a peripheral surface and a second shoulder in said stepped bore adjacent said second end;

25        a second spring that is located in said axial bore and engaging said first shoulder on said second cylindrical member for urging said first end and said second seat thereon toward said annular face on said first cylindrical member;

30        a key retained in a slot in said cylindrical body of said hub with first and second legs that extend past the peripheral surface of said cylindrical body, said first and second legs being located in said groove

between said first and third diameters of said first shaft of said first plunger means to limit the axial movement of said first plunger means to a linear distance corresponding to said slot, said return spring acting on said hub to bring said key into engagement with a stop on said housing  
5 in said first mode of operation;

a third spring that is located between said retainer and said push rod for urging said first plunger means toward said retainer to allow said second spring to move said second seat on said first end of said second cylindrical member into engagement with said annular face on said first  
10 cylindrical member such that said first passage is in communication with said second passage in the first mode of operation;

a second plunger means including a cylindrical body that surrounds said second shaft of said first plunger means, said cylindrical body of said second plunger means having a groove for receiving said lip through  
15 which said cylindrical body is connected to said second cylindrical member;

a solenoid that is concentric to said cylindrical body of said second plunger means, said solenoid on receipt of said electrical input functioning as said second input member to provide force for moving said  
20 cylindrical body of said second plunger within said axial bore of said hub and correspondingly moving said first end and said second seat on said second cylindrical member away from said annular face on said first cylindrical member after said first spring moves said annular face into engagement with said first seat to terminate communication between  
25 said second chamber and said first chamber through said first passage and thereafter allow air to be communicated to said second chamber through said second passage to initiate said second mode of operation and effect said second brake application; and

a switch having a sensor retained in said hub and an exciter  
30 element attached to said key, said sensor moving with said hub and away from said exciter as said key and said first plunger remain stationary with respect to said hub in said second mode of operation

during said second brake application, said movement of said sensor away from said exciter creating and sustaining said first signal until an input force from said first input member act on said first plunger to move said key and position said exciter adjacent said sensor to develop said second 5 signal whereby said ECU terminates said electrical input to said solenoid and the development of said first brake application as a function of a manual input.

6. The brake booster as recited in claim 5 wherein the development of said first signal by movement of said hub only occurs 10 when said electrical signal is supplied to said solenoid said ECU.

7. The brake booster as recited in claim 6 wherein said exciter is a magnetic chip carried by said key.

8. The brake booster as recited in claim 7 wherein only second shaft receives a reaction force to oppose the actuation force developed 15 by the solenoid during a second brake application.

9. A brake booster having a housing with an interior separated into a first chamber and a second chamber by a wall that is connected to a hub, said hub having a cylindrical body with an axial bore therein for receiving a control valve assembly that sequentially connecting said first 20 chamber with said second chamber through a first passage in the hub to provide for the equalization of fluid pressure therein in a first mode of operation and interrupting communication through said first passage while connecting said second chamber to a surrounding environment through a second passage to allow air to enter said second chamber and 25 create a pressure differential across said wall in a second mode of operation, said pressure differential acting on said wall to develop an output force, that after overcoming a force of a return spring, is transmitted through said hub to an output push rod for moving pistons located in a master cylinder to pressurizes fluid that is communicated to 30 wheel brakes to effect a brake application, said brake booster being characterized by a first input member that is connected to said control valve assembly and responsive to a first force supplied by an for moving

said control valve assembly from said first mode of operation to said second mode of operation to develop a first brake application, a second input member that is connected to said control valve assembly and responsive to a second force derived from a solenoid under the control of

5 an electronic control unit for moving said control valve assembly from said first mode of operation to said second mode of operation to develop a second brake application and switch means initially responsive to movement of said hub in the development of said second mode of operation by said second input member for providing an ECU with a first

10 signal confirming the development of said second brake application and later responsive to movement of said control valve assembly by said first input member for providing said ECU with a second signal whereby said second brake application is terminated and said first brake application is initiated, said control valve being characterized by:

15 a first cylindrical member that is sealingly located in said axial bore with an annular face thereon that defines a vacuum seat;

20 a retainer fixed to said cylindrical body for sealingly retaining said first cylindrical member within said axial bore;

25 a first spring located in said axial bore for urging said annular face toward a first seat associated with said first passage;

30 a first plunger means including a first shaft and a second shaft located in said axial bore, said first shaft having a groove located between a first end and a second end, said first end being connected to said first input member, said second shaft having an end that contacts said first shaft and an end that contacts a reaction disc associated with said output push rod;

35 a second cylindrical member with a stepped bore that receives said first shaft and a face on a first end that defines an atmospheric seat, a second end with a lip thereon, a first shoulder located on its a peripheral surface and a second shoulder in said stepped bore adjacent said second end;

a second spring located in said axial bore and engaging said first shoulder on said second cylindrical member for urging said first end and said atmospheric seat thereon toward said annular face on said first cylindrical member;

5       a key retained in a slot in said cylindrical body of said hub with first and second legs located in said groove of said first shaft, said groove and slot limiting the axial movement of said first plunger means within the axial bore, said return spring acting on said hub to position said key and first plunger in a rest position in said first mode of  
10      operation;

      a third spring located between said retainer and said push rod for urging said first plunger means toward said retainer to allow said second spring to move said atmospheric seat on said second cylindrical member into engagement with said annular face on said first cylindrical member  
15      such that said first passage is in communication with said second passage in said first mode of operation;

      a second plunger means including a cylindrical body that surrounds said second shaft, said cylindrical body of said second plunger means being connected to said on said second cylindrical member;

20       a coil that surrounds said cylindrical body of said second plunger means, said coil on receipt of said electrical input functioning as a solenoid to move said cylindrical body of said second plunger means to a center position within said coil and correspondingly moving said vacuum away from said annular face after said first spring moves said moves said  
25      annular face into engagement with said vacuum seat to terminate communication through said first passage and thereafter allow air to be communicated to said second chamber through said second passage to develop said second mode of operation and initiate said second brake application; and

30       a switch having a sensor retained in said hub and an exciter element attached to said key, said sensor during said second brake application moving with said hub and away from said exciter as said key

and said first plunger means remain in a stationary position with said axial bore to create and sustain a first signal until an input force applied by an operator to said first input member act moves said first plunger and said key to position said exciter adjacent said sensor to create said 5 second signal whereby said ECU terminates said electrical input to said coil and the control of said control valve assembly is switched to the first input member to thereafter develop of said first brake application.